Remarks

Applicant requests reconsideration of the application in view of the following remarks.

Rejection of Claims 1, 6, 8 and 20

Claims 1, 6, 8 and 20 were rejected under 35 U.S.C.§ 102(b) as allegedly being anticipated by U.S. Patent No. 4,278,307 to Olchewski et al. (Olchewski). Applicant traverses this rejection and requests that it be withdrawn.

Independent claim 1 recites a method of swaging a spherical bearing comprising a ball and a bearing housing, the method comprising:

> providing a ball and a bearing housing to be swaged around the ball;
> creating a temperature differential between the temperature of the housing and the temperature of the ball, the ball being at a lower temperature than the housing such that the relative size of the ball with respect to the housing decreases;
> inserting the ball in the housing;
> swaging the housing around the ball, the ball being cooler than the housing during the swaging process;
> allowing the ball and housing to return to ambient temperature such that the relative size of the ball with respect to the housing increases.

Olchewski does not teach or suggest the method recited in claim 1. Olschewski describes a bearing assembly, wherein balls 3 are snapped into holding projections 4 of a snap cage 1 made of plastic material (column 2, lines 18 to 24). To ensure that the "snap-in fasteners" (the holding projections) will not open again, spreadable pins 5 are provided between the holding projections. These pins are plastically deformed/upset to form head part 6 which engage with the holding projections and thereby secure their position. (column 2, lines 28 to 32.) The cage may be heated, so that the plastic material is softened. (column 3, lines 25 to 31).

Firstly, there is no disclosure in Olschewski that there is a change in the relative size of the ball with respect to the housing. The action's assertion that heating the plastic cage would inherently cause expansion is incorrect. It is disclosed in Olschewski that heating the housing causes it to soften; but it is not inherent that it will also expand as a result.

Secondly, there is no disclosure in Olschewski of a swaging step. Swaging is a forming process whereby the dimensions of a component are altered by forcing the component into a die or equivalent device. Indeed, there is no need to use swaging in Olschewski because of the resiliency of the plastic housing.

In the method of claim 1, the use of both a temperature differential and swaging step conveniently allows for a reduction in the disadvantageous effects of "spring-back," described in depth in the application as filed. No such problems are encountered with the arrangement of Olschewski, because the plastic housing would not expand when heated.

Accordingly, for at least the foregoing reasons, claim 1 is not anticipated by Olschewski and should be allowed.

To the extent that the swaging step is construed to cover deforming plastic head parts 6 in Olschewski (which would be improper), Applicant have added new claim 22, which specifies that the act of swaging comprises reducing a gap between the ball and an inner surface of the housing. Olschewski actually teaches against reducing the clearance between the balls 3 and the respective projections 4. For example, Olschewski teaches: "It is important that the head parts 6 not be deformed so far as to abut the holding projections 4, in order to avoid rigid clamping of the balls in the cage pockets by the pressing of the head parts 6 on the holding projections." (col. 2, lines 35-39.) Thus, to the extent that deforming head parts 6 is considered to be "swaging" the housing around balls 3, the "swaging" step clearly does not reduce the gap or clearance between the balls and inner surfaces of the housing.

Claims 6, 8 and 20 depend from claim 1 and are patentable for the reasons given above in support of claim 1. Moreover claims 8 and 20 further specify that the act of swaging comprises a taper die swaging process. In the rejection of claims 8 and 20, the action states that Olschewski teaches use of a tool to deform portions 6 of the cage into "taper shaped swaged elements." The action alleges that this teaching constitutes a taper die swaging process. This is incorrect. A taper die swaging process is known in the art as a process whereby a component is formed by forcing the component through a tapered opening of a die. (see Figure 4 of the present application.) Olschewski clearly does not teach or suggest a taper die swaging process and it is improper to interpret the limitation "taper die swaging process" in a manner that is inconsistent with its meaning in the art, as done in the action. In any case, to distinguish the purported "tapered die swaging process" of Olschewski, Applicant also has added new claim 23 to further specify that the swaging process comprises placing the ball and the housing in a tapered opening of a die and swaging the housing around the ball.

Rejection of Claims 2, 11 and 18

Claims 2, 11 and 18 were rejected under 35 U.S.C.§ 103(a) as allegedly being obvious over Olchewski in view of U.S. Patent No. 2,995,813 to Board Jr. (Board). Applicant traverses this rejection and requests that it be withdrawn.

Claims 2, 11 and 18 depend from claim 1 and are patentable for the reasons given above in support of claim 1 and because each claim sets forth an independently patentable combination of features.

Claim 2 specifies that "the ball is manufactured of a first material and the housing is manufactured of a second material, the two materials being different from one another." The action argues that using different materials for the ball and the housing, as recited by claim 2, is obvious over Olschewski. Olschewski does not disclose different materials, but simply that the cage is made of plastic. The action alleges that the ball of Olschewski has to be a different material from the housing so as not to be effected by the softening/deformation process. Applicant disagrees with this finding. Since Olschewski only deforms the pins and not the projections 4 it should have made no difference if the ball was the same material as the housing and therefore softened in addition. There is no pressure on the ball in Olschewski. (column 2, lines 35 to 39.) Hence no deformation of the ball in Olschewski can be expected.

The action also alleges that it would have been obvious to modify Olschewski to include a metal ball, as taught by Board. Applicant disagrees.

Board discloses a known method of swaging a metal-to-metal bearing. Instead of "hammering" the outer race around and on to the ball, an extrusion process is used. The extrusion die has a conical opening into which the ball race assembly is forced axially. There is no disclosure in Board as to creating a temperature differential between the ball and housing. Moreover, there is no appreciation in Board of the problems associated with spring-back. Indeed, even if the skilled person was to create a temperature differential between the ball and housing of Board, the extrusion swaging method deployed in Board inherently creates very high temperatures, which would affect both the housing and the ball. The advantageous effects of a temperature differential would therefore be lost at the very start of swaging.

The skilled artisan would not combine the disclosure of Olschewski and Board, because they relate to different areas of technology and, moreover, to different methods of assembly.

Olschewski relies on a ball "snap-fitting" into a plastic housing while Board relates to a method of swaging a metal-to-metal bearing.

Rejection of Claims 3, 7, 12. 19 and 21

Claims 3, 7, 12, 19 and 21 were rejected under 35 U.S.C.§ 103(a) as allegedly being obvious over Olchewski in view of U.S. Patent No. 5,421,088 to Kawamura (Kawamura). Applicant traverses this rejection and requests that it be withdrawn.

Claims 3, 7, 12, 19 and 21depend from claim 1 and are patentable for the reasons given above in support of claim 1 and because each claim sets forth an independently patentable combination of features.

Claim 3 recites that the temperature differential is created by cooling the ball and claim 7 recites that the temperature differential is caused by heating the housing and cooling the ball.

The action concedes that Olchewski does not teach creating a temperature differential by cooling a ball, but contends that it would have been obvious to employ cooling of the ball and heating of the housing in Olchewski, as taught by Kawamura. Applicant disagrees that it would have been obvious to modify Olchewski in this manner.

Olchewski's snap cage 1 must be heated after insertion of balls 3 in order to deform projections 6. Cooling the balls 3 just prior to insertion into the cage would inhibit subsequent heating of the cage, and therefore would make the assembly process more time consuming. In addition, the projections 4 of the cage 1 are adapted to elastically deform to permit the balls to be "snapped into the pockets without difficulty." (col. 2, lines 23-24.) Hence, Olchewski inherently teaches against cooling balls 3 during the assembly process because cooling the balls would only serve to complicate the assembly process without adding any apparent benefits. Moreover, since the cage 1 must be heated after the balls are inserted into the projections, there is no way to assure that the balls remain cooler than the surrounding cage during the "swaging" process, as required in the claims. Furthermore, assuming for argument's sake that heating causes the cage and the balls to expand, during subsequent cooling back to ambient temperature both the balls and the cage would contract. In other words, when the balls and the cage are allowed to return to ambient temperature, the relative size of the ball with respect to the housing would stay the same, in contrast to claim 1 which specifies that the size of the ball with respect to the housing increases.

Furthermore, Kawamura discloses a method of assembling a double-row ball bearing of the pre-load type. Kawamura does not swage any part of the bearing. The balls are assembled into a crescent gap between the outer and inner race and aligned around the circumference using a jig. With such double-row ball bearing assemblies, there is a need to apply a pre-load, which is provided by producing a temperature differential between at least one of the outer and inner race and the balls, thereby increasing the gap between the balls and the races. (column 2, lines 59.)

There is no disclosure in Kawamura of a swaging step. The inner and outer races of Kawamura are preformed in their final state. In Kawamura, there is an intentional loading between the races and the balls. By contrast, there should be no such inherent high "loading" between the ball and a housing of a spherical bearing arrangement, such as with that of the instantly claimed method. With spherical bearing assemblies, as is well known in the art, there must be a predetermined torque between the ball and housing. Should the torque be too high, then rotation of the ball with respect to the housing would be difficult. The level of torque created by the "pre-load" taught in Kawamura would simply not be applicable to a spherical bearing of the type recited in claim 1. The purpose of the temperature differential in Kawamura is to restore "negative gaps" (i.e., an interference fit). In the instantly claimed method, on the other hand, the temperature differential is only provided to reduce or eliminate the disadvantageous effects of spring-back - *i.e.*, to remove a "positive gap" but not necessarily to create a "negative gap." As disclosed on lines 24 to 27 of page 1 of the application as filed, if spring-back is not compensated, then the swaged part of the housing will not conform to the shape of the ball, meaning a (positive) gap is created between the edge of the swaged housing and the ball, resulting in a loose fitting bearing. The advantageous effect of the method recited by claim 1 is that spring-back is reduced or eliminated.

Accordingly, the use of the temperature differential as disclosed in Kawamura would simply not be compatible with the present invention. Moreover, there would be no incentive to combine the features of Kawamura with Olschewski, because they relate to different fields. As previously discussed, even if the temperature differential were to be deployed in Olschewski, the plastic housing would not expand.

Rejection of Claims 4, 5 and 13-14

Claims 4, 5 and 13-14 were rejected under 35 U.S.C.§ 103(a) as allegedly being obvious over Olchewski in view of Kawamura and U.S. Patent No. 5,150,636 to Hill (Hill). Applicant traverses this rejection and requests that it be withdrawn.

Claims 4, 5 and 13-14 depend from claim 1 and are patentable for the reasons given above in support of claim 1 and because each dependent claim sets forth an independently patentable combination of features.

Claim 4 recites that the ball is cooled to below 0°C and claim 5 further recites that the ball is cooled by liquid nitrogen. In the rejection of these claims, the action concedes that Olchewski and Kawamura do not teach cooling below 0°C or cooling by liquid nitrogen. But, the action contends that it would have been obvious to employ liquid nitrogen, as taught by Hill, to cool the balls of the Olschewski as modified by Kawamura.

On the contrary, one skilled in the art would not have been motivated to cool the bearing balls of Olschewski to liquid nitrogen. Liquid nitrogen can cool a bearing ball to about -196°C. Using liquid nitrogen to assemble the Olschewski device would only complicate the assembly of the device because additional steps and time would be needed to first cool the balls and then to heat the assembly for deforming portions 6, when in fact the Olschewski cage 1 is specifically design to allow assembly of the balls into the projections 4 "without difficulty."

Moreover, Hill teaches a method of replacing a cutting head of a rock drill. The rock drill is removed from the cutting head by cooling the rock drill so as to reduce the interference fit between the two. Hill relates to an entirely separate field of technology, not even in the general field of bearings. Only with the benefit of improper hindsight analysis would one skilled in the art of bearings look to the teachings of Hill. For the same reasons as submitted in relation to Kawamura, there is no incentive for the skilled person to combine the features of Hill with Olschewski.

Rejections of Claims 10, 15, 16 and 17

Claims 10 and 15 were rejected under 35 U.S.C.§ 103(a) as allegedly being obvious over Olchewski in view of Kawamura and Board. Claims 16 and 17 were rejected under 35 U.S.C.§ 103(a) as allegedly being obvious over Olchewski in view of Kawamura, Board and Hill. Applicant traverses these rejections and requests that they be withdrawn.

Claims 10, 15, 16 and 17 depend from claim 1 and are patentable for the reasons given above in support of claim 1 and because each dependent claim sets forth an independently patentable combination of features.

Conclusion

The present application is in condition for allowance and such action is respectfully requested. If any issues remain concerning this application, the examiner is requested to contact the undersigned attorney to expedite prosecution of the application.

Respectfully submitted,

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